PART 1: Chapter 5 Economic Interdependency between Japan and USA, and Asia-Pacific Region: 2 A Multiplier Analysis of Industrial Linkages between Japan, the United States and Developing Asia

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Paper 2

A Multiplier Analysis of Industrial Linkages between Japan, the United States and Developing Asia

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Introduction

Industrial development in the Asia-Pacific region in the post World War II era has been the most striking incidence in economic history. The industrialization process which started in Far East after the war has spread to Southeast Asia and then to the coastal provinces of China. The economies of the region have by no means developed independently from each other. Rather, they have been undergoing continuous structural changes in which industries of different strata of technological levels have been shifting from one economy to another. As a consequence, there has emerged a huge industrial belt in the West-Pacific rim of Asia.

The compilation of the 1975 International Input-Output Table for ASEAN was an epoch-making work in economic statistics. It made possible, for the first time, to make structural analyses of inter-industry relations developed through the so called flying geese development. Making use of this table, Furukawa [1986] demonstrated, *inter alia*, the fact that the interdependent relationship in intermediate inputs in heavy and chemical industries between the ASEAN countries and Japan was far more intensive in comparison with that between ASEAN and the United States.

In earlier occasions, I analyzed intertemporal structural changes in industrial linkages in the Asia-Pacific region using preliminary estimates for the data for 1985 and different methodologies, and showed some evidences of structural adjustments undertaken by the economies of the region during the 1975 – 1985 period (Nakamura [1990]). Now upon the completion of the 1985 table, it has become possible to conduct analyses on the basis of a more solid and detailed database.

The major purpose of this paper is to analyze the interdependent structure of the industrial linkages between Japan, the United States and the developing part of Asia. A comparison of the production linkages of Japan and the United States with the Asian developing countries and their changes over time are the main focal points of this study.

Table 1 Decomposition of Induced Output by Final Demand of Different Origins

(100 million US dollars)

Output of		Output Induced by the Final Demand of			Total Output
		Developing Asia	Japan	U.S.	
Developing Asia	1975	1493 (80.1)	86 (4.6)	83 (4.5)	1864 (100)
	1985	4466 (74.4)	258 (4.3)	408 (6.8)	6002 (100)
Japan	1975	149 (1.3)	9880 (86.5)	285 (2.6)	11428 (100)
	1985	303 (1.1)	23254 (83.9)	1561 (5.6)	27722 (100)
U.S.	1975	78 (0.3)	202 (0.7)	26721 (91.7)	29140 (100)
	1985	203 (0.3)	420 (0.6)	68392 (93.1)	73452 (100)

Note: Figures in parentheses are percentage composition by origin of final demand.

Table 1 shows the share composition of induced gross outputs in the three regions analyzed in this paper by final demand originating from these regions. Except that (1) the share of the induced output by external demand in Developing Asia increased markedly, and (2) that the final demand of the U.S. induced relatively more outputs of Developing Asia and Japan in 1985 than in 1975, no great changes are observed during the period. Nonetheless, Table 1 gives a supporting evidence to a common understanding of the outward oriented economic development of developing countries in Asia and the increased dependence of the U.S. on Asia for the supply of its final demand products.

This paper aims to further analyze the developments taking place at the micro level of the industrial linkages in the Asia-Pacific region which were latent under such changes as are shown in Table 1. The analysis is done by decomposing multiplier effects into several components having explicit geographical dimensions.

Section 1 of this paper describes the methodology and data employed in this study. Section 2 presents major findings obtained, and Section 3 tries to provide an insight on possible changes after 1985 and some supporting evidences. Section 4 concludes the paper.

1. Multiplier Matrix in a Three-Region Input-Output System

1-1 Methodology

The method employed in this analysis of international industrial linkages is the one developed and presented in Round [1985]. It aims to decompose an overall impact multiplier in an input-output framework into intra-regional and inter-regional multipliers with explicit considerations of geographical directions.

Letting y_i denote the gross output vector for region i, x_i the final demand vector and B_{ij} the input coefficient matrix defined over transactions in intermediate inputs of goods and services between regions i and j,

$$\begin{bmatrix} y_1 \\ y_2 \\ y_3 \end{bmatrix} = \begin{bmatrix} B_{11} & B_{12} & B_{13} \\ B_{21} & B_{22} & B_{23} \\ B_{31} & B_{32} & B_{33} \end{bmatrix} \begin{bmatrix} y_1 \\ y_2 \\ y_3 \end{bmatrix} + \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix}$$

holds for a system consisting of three regions. This equation can be solved for the outputs as

$$y = (I - D)^{-1} (I-B)^{-1} x,$$

where $x = (x_1', x_2', x_3')'$, $y = (y_1', y_2', y_3')'$,

$$(I - B)^{-1} = \begin{bmatrix} (I- B_{11})^{-1} & 0 & 0 \\ 0 & (I - B_{22})^{-1} & 0 \\ 0 & 0 & (I - B_{33})^{-1} \end{bmatrix},$$

$$(I - D)^{-1} = \begin{bmatrix} I & -D_{12} & -D_{13} \\ -D_{21} & I & -D_{23} \\ -D_{31} & -D_{32} & I \end{bmatrix}^{-1}, \text{ and}$$

$$D_{ij} = (I - B_{ii})^{-1} B_{ij}, \text{ or}$$

$$y = M_{rx} M_{r1} x.$$

M_{rl} is the intra-regional multiplier matrix. The zero off diagonal submatrices indicate that M_{rl} does not capture inter-regional repercussions at all. The diagonal submatrices are similar to one in a single region system.

M_{rx}, on the other hand, can be called the inter-regional multiplier matrix. It captures all the repercussions between the three regions, but excludes intra-regional effects since they are already accounted for by M_{rl}. It should be noted that M_{rx} depends on the intensity of trade in intermediate inputs and intra-regional multipliers.

Letting

$$h = (I - B)^{-1} x ,$$

we have

$$y = (I - D)^{-1} h ,$$

which can be rewritten as

$$y_i - D_{ij} y_j - D_{ik} y_k = h_i .$$

By solving these simultaneous equations, one gets

$$\begin{bmatrix} y_1 \\ y_2 \\ y_3 \end{bmatrix} = \begin{bmatrix} H_{11} & 0 & 0 \\ 0 & H_{22} & 0 \\ 0 & 0 & H_{33} \end{bmatrix} \begin{bmatrix} I & L_{12} & K_{13} \\ K_{21} & I & L_{23} \\ L_{31} & K_{32} & I \end{bmatrix} \begin{bmatrix} h_1 \\ h_2 \\ h_3 \end{bmatrix},$$

where

$$H_{ii} = [I - D_{ij} D_{ji} - (D_{ik} + D_{ij} D_{ik}) (I - D_{kj} D_{jk})^{-1} (D_{ki} + D_{kj} D_{ji})]^{-1} ,$$

$$K_{ik} = (D_{ik} + D_{ij} D_{jk}) (I - D_{kj} D_{jk})^{-1} , \text{ and}$$

$$L_{ij} = D_{ij} + K_{ij} D_{kj} .$$

Thus, the overall mutiplier matrix can be multiplicatively decomposed as

$$y = M_{r3} M_{r2} h$$

$$= M_{r3} M_{r2} M_{r1} x .$$

Since M_{r3} is a block diagonal matrix, it shows the magnitude of impacts of production increases in one region on the same region after accounting for all intra-regional repercussions. Besides, the diagonal submatrices of M_{r3} involve inter-regional multipliers. Thus, M_{r3} can be interpreted as representing inter-regional feedback effects on own regions, and may be referred to as an inter-regional "closed loop" multiplier matrix. In contrast, M_{r2} captures the impacts which one region has on the others after accounting for all own-region effects, and may therefore be referred to as an inter-regional "open loop" multiplier matrix. L_{12}, a submatrix of M_{r2}, represents the multiplier effects from region 2 on region 1. Likewise, K_{21} represents those from region 1 on region 2.

1-2 Data

The 24-sector International Input-Output Tables developed by the Institute of Developing Economies are used as the primary data source in this analysis. The tables are available for 1975 and 1985. However, in order to conduct intertemporal comparisons, the ten-country system for 1985 had to be reduced to an eight-country system because China and Taiwan are endogenous in the 1985 table but not in the 1975 table. Next, the five ASEAN member countries and Korea are aggregated[1] into a region called Developing Asia. The three regions included in the analysis are, 1: Developing Asia, 2: Japan, and 3: the United States.

2. Multiplier Decomposition Analysis: Major Findings

The submatrices of the intra-regional multipliers, the closed and open loop multiplier matrices have been computed on the basis of the 24-sector table. However, due to space limitations only the column totals of the submatrices are presented for the selected sectors of manufacturing. Column totals represent total backward linkage effects. Intertemporal comparisons between 1975 and 1985 are also made.

2-1 M_{r1} : Intra-regional Multiplier

Intra-regional multiplier effects naturally account for the largest part of overall effects. Table 2 shows the column totals of the intra-regional multiplier matrices which represent the total backward linkage effects for the three regions in 1975 and 1985, and the changes between the two years.

The changes in the intra- regional multipliers between 1975 and 1985 show contrasting pictures among the three regions. While the subsectors of manufacturing of Developing Asia experienced big gains in the backward linkage effects, those of Japan saw large losses. The backward linkage effects within Developing Asia on the food, paper, petroleum products, rubber products, metal products, transport equipment and other manufacturing sectors increased substantially. In the case of the Japanese manufacturing industry, decreases in the food, chemical, transport equipment and other manufacturing sectors are particularly notable. The results for the U.S. are mixed. While large decreases are observed

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[1] The diagonal elements of the original I/O table were deleted before the aggregation in order to avoid problems peculiar to "own inputs". The differences in data collecting practices (a product basis or an establishment basis, etc.) and other factors are pointed out as the potential source of biases.

Table 2 Intra-regional Multiplier, Total Backward Linkage Effects

(1) Developing Asia

		1985	1975	85 – 75
8	Food Product	18708	17959	749
9	Textile	15219	14858	361
10	Wood Product	17318	17226	92
11	Paper & Printing	14995	14091	904
12	Chemical Product	15411	15297	114
13	Petroleum Product	14065	12356	1709
14	Rubber Product	16053	14228	1825
15	Non-metal Mineral Product	17076	16630	446
16	Metal Product	15677	14776	901
17	Machinery	14779	14500	279
18	Transport Equipment	15362	14033	1329
19	Other Manufactures	16558	15743	815

Note: Figures in this table represent the column totals of $M_{r\,1}$ for the corresponding subsectors. All the figures are multiplied by 10000, hence, 18708, for instance, should read 1.8708.

(2) Japan

		1985	1975	85 – 75
8	Food Product	18878	19812	–934
9	Textile	17065	17695	–630
10	Wood Product	17114	17265	–151
11	Paper & Printing	16159	16411	–252
12	Chemical Product	16964	17985	–1021
13	Petroleum Product	11815	12005	–190
14	Rubber Product	18958	19094	–136
15	Non-metal Mineral Product	18035	18509	–474
16	Metal Product	16059	16208	–149
17	Machinery	17345	17892	–547
18	Transport Equipment	18495	19464	–969
19	Other Manufactures	17891	19308	–1417

Note: See note to Table 2(1).

Table 2 Intra-regional Multiplier, Total Backward Linkage Effects (continued)

(3) The United States

		1985	1975	85 – 75
8	Food Product	21190	23889	-2699
9	Textile	17561	15684	1877
10	Wood Product	17606	16419	1187
11	Paper & Printing	15953	15285	668
12	Chemical Product	18116	15860	2256
13	Petroleum Product	18346	21832	-3486
14	Rubber Product	18160	17738	422
15	Non-metal Mineral Product	17393	16435	958
16	Metal Product	16848	16028	820
17	Machinery	16088	15294	794
18	Transport Equipment	17641	18316	-675
19	Other Manufactures	17049	16170	879

Note: See note to Table 2(1).

for the food and petroleum product sectors, the effects on the other sectors generally increased.

These observations strongly suggest the progress of industrial relocations from Japan to Developing Asia during the period of the analysis. This inference will be further substantiated in what follows, by examining inter-regional multipliers.

2-2 M_{r2} : Inter-regional Open Loop Multipliers

Table 3 shows a summary of changes in the six submatrices of the open loop multiplier matrix, M_{r2}. One could easily notice that the total "open loop" backward linkage effects from Developing Asia on Japan (K_{21}) are by far the largest among the triangle relations in the Asia-Pacific region. Moreover, larger negative changes in the effects are also observed in this geographical direction than in the others. In terms of the magnitude of column totals, L_{31} (the effects from Developing Asia on the U.S.) and K_{32} (those from Japan on the U.S.) seem to follow K_{21}.

(L_{12} , K_{21} : Open loop multipliers between Developing Asia and Japan)

L_{12} shows the total backward linkage effects the Japanese industries have on the industries of Developing Asia. K_{21} shows the effects in the opposite direction.

Immediately noticeable are large backward linkage effects of the heavy industrial sectors (16: metal products, 17: machinery, 18: transport equipment) of Developing Asia have on Japan (K_{21}). The changes in the magnitude of these effects between 1975 and 1985 are quite impressive. The decreases in the effects on the metal product and transport equipment sectors are particularly large. In contrast, a slightly positive change is observed for the machinery sector.

The backward linkage effects of the Japanese industry on Developing Asia (L_{12}) are smaller than the counterpart effects shown in K_{21} with the exception of those on the petroleum product sector and a few others. The changes during the period of the analysis, however, are generally positive.

These observations, together with the increasing intra-regional multiplier effects in Developing Asia pointed out above, indicate the substantial shift of production bases by 1985 from Japan to Developing Asia. The changes in K_{21} are by no means uniform. They tend to be large for the sectors from which backward linkage effects themselves are strong. This implies that the production shifts were taking place in the areas where there had been intensive flows of supply from Japan to Developing Asia for a considerable period of time, and perhaps related technologies had been digested by the recipient side.

(K_{13} , L_{31} : Open loop multipliers between Developing Asia and the U.S.)

A similar pattern of industrial linkages is observed between Developing Asia and the U.S. to that between Developing Asia and Japan, although the total backward linkage effects in the former relation are less intensive compared with those in the latter. L_{31} representing the backward linkage effects of developing Asia on the U.S. industry shows relatively larger effects on the light industries of the U.S. such as textile and paper when compared with K_{21} . In relative terms, the Japan-Developing Asia industrial linkages are dominated by those in machinery, while the U.S.–Developing Asia linkages are intensive in light manufacturing sectors. No big changes are observed in the latter during the period of the analysis.

(L_{23} , K_{32} : Open loop multipliers between Japan and the U.S.)

The industrial linkages between Japan and the U.S. shown in the open loop multipliers are less intensive in comparison with those of the two countries with Developing Asia. While the backward linkage effects of Japan on the U.S. industries (K_{32}) were lopsided towards light industries, those in the opposite direction (L_{23}), though on much lower levels, are concentrated in machinery. K_{32} shows declining trends in the impacts of Japan on the U.S. industries.

2-3 M_{r3} : Inter-regional Closed Loop Multipliers

The diagonal submatrices of M_{r3} , the closed loop multiplier matrix, are very close to an identity matrix. In other words, the multiplier effects originating from one region and coming back on itself after accounting for the intra-regional effects and the inter-regional open loop effects, are very weak. Although the changes in the total backward linkage

Table 3 Inter-regional Open Loop Multipliers, Total Backward Linkage Effects

L_{12}

(Effects from Japan on Developing Asia)

		1985	1975	85 – 75
8	Food Product	149	266	–117
9	Textile	173	235	–62
10	Wood Product	493	418	75
11	Paper & Printing	40	53	–13
12	Chemical Product	277	115	162
13	Petroleum Product	803	765	38
14	Rubber Product	546	117	129
15	Non-metal Mineral Product	79	16	33
16	Metal Product	242	128	114
17	Machinery	51	43	8
18	Transport Equipment	21	16	5
19	Other Manufactures	51	34	17

K_{21}

(Effects from Developing Asia on Japan)

		1985	1975	85 – 75
8	Food Product	68	55	13
9	Textile	826	1437	–611
10	Wood Product	144	332	–188
11	Paper & Printing	511	981	–470
12	Chemical Product	1026	1971	–945
13	Petroleum Product	30	7	–43
14	Rubber Product	656	817	–161
15	Non-metal Mineral Product	339	351	–12
16	Metal Product	1307	2485	–1178
17	Machinery	2033	1988	45
18	Transport Equipment	1925	3221	–1296
19	Other Manufactures	1068	1689	–621

Note: Figures in these tables represent the column totals of L_{12} and K_{21} for the corresponding subsectors. All the figures are multiplied by 10000.

Table 3 Inter-regional Open Loop Multipliers, Total Backward Linkage Effects (continued)

K_{13}

(Effects from the U.S. on Developing Asia)

		1985	1975	85 – 75
8	Food Product	52	44	8
9	Textile	150	83	67
10	Wood Product	41	29	12
11	Paper & Printing	6	10	–4
12	Chemical Product	27	21	6
13	Petroleum Product	178	42	136
14	Rubber Product	337	31	306
15	Non-metal Mineral Product	16	13	3
16	Metal Product	52	44	8
17	Machinery	134	35	99
18	Transport Equipment	42	32	10
19	Other Manufactures	59	28	31

L_{31}

(Effects from Developing Asia on the U.S.)

		1985	1975	85 – 75
8	Food Product	285	453	–168
9	Textile	923	1077	–154
10	Wood Product	406	321	85
11	Paper & Printing	874	716	158
12	Chemical Product	972	721	251
13	Petroleum Product	282	173	109
14	Rubber Product	319	207	112
15	Non-metal Mineral Product	316	121	195
16	Metal Product	484	705	–221
17	Machinery	1423	1214	209
18	Transport Equipment	404	583	–179
19	Other Manufactures	545	489	56

Note: Figures in these tables represent the column totals of K_{13} and L_{31} for the corresponding subsectors. All the figures are multiplied by 10000.

Table 3 Inter-regional Open Loop Multipliers, Total Backward Linkage Effects (continued)

L_{23}

(Effects from the U.S. on Japan)

		1985	1975	85 – 75
8	Food Product	16	29	–13
9	Textile	149	125	24
10	Wood Product	33	48	–15
11	Paper & Printing	29	23	6
12	Chemical Product	59	63	–4
13	Petroleum Product	7	11	–4
14	Rubber Product	65	68	–3
15	Non-metal Mineral Product	40	33	7
16	Metal Product	199	226	–27
17	Machinery	315	186	129
18	Transport Equipment	321	218	103
19	Other Manufactures	131	84	47

K_{32}

(Effects from Japan on the U.S.)

		1985	1975	85 – 75
8	Food Product	559	767	–208
9	Textile	363	288	75
10	Wood Product	627	1064	–437
11	Paper & Printing	309	354	–45
12	Chemical Product	321	318	3
13	Petroleum Product	207	655	–448
14	Rubber Product	117	244	–127
15	Non-metal Mineral Product	143	265	–122
16	Metal Product	303	164	139
17	Machinery	199	156	43
18	Transport Equipment	199	118	81
19	Other Manufactures	158	116	42

Note: Figures in these tables represent the column totals of L_{23} and K_{32} for the corresponding subsectors. All the figures are multiplied by 10000.

effects computed as the column totals of H_{11}, H_{22} and H_{33} are small, it may be worthwhile to note that there were slight rises in the feedback effects of a demand increase for rubber products in Japan (from 1.0011 in 1975 to 1.0041 in 1985) and machinery in the U.S. (from 1.0005 to 1.0018). The significance of these rises, however, are not clear.

2-4 An Inter-industry Examination of Open Loop Multipliers

Now, we come back to the open loop multiplier effects between the regions, and directly look at the individual elements of the submatrices representing inter-industry relations between the subsectors of manufacturing. K_{21} and L_{31}, the two submatrices of M_{r2}, are closely examined to grasp the structural differences in the industrial interdependency between Japan and Developing Asia and that between the U.S. and Developing Asia.

Table 4 illustrates the relative magnitude of inter-industry multiplier effects of the subset of K_{21} for manufacturing sectors. The symbols in the row for the 9-th industry shows, for instance, the multiplier effects on the textile industry of Japan by an unit increase in demand for the sectors of Developing Asia in the column head. In this case, demand for the textile and rubber product sectors of Developing Asia, for instance, are shown to have had noticeable multiplier effects on the textile sector of Japan. Likewise, the symbols in Table 5 show the effects of demand increases in Developing Asia on the manufacturing sectors of the U.S.

One would immediately find that K_{21} is more "crowded"than L_{31}, which indicates that demand increases in Developing Asia had more intensive multiplier effects on the Japanese manufacturing sectors than those of the U.S. in 1985. In the both tables there are blocks into which the multiplier effects concentrate. One of them is the block involving the paper (11) and chemical product (12) sectors, and the other is the one consisting of the metal product (16) and machinery (17 and 18) sectors. The concentration of the effects in the metal product and machinery sectors between Japan and Developing Asia is particularly intensive. The differences between the 18-th columns (transport equipment) in the two tables are very significant. While a demand increase for the transport equipment sector of Developing Asia had only limited multiplier effects on the U.S. industries, the same increase produced significant consequences in Japan. These imply that Developing Asia had more intensive intra- and inter-industry division of labor in the metal product and machinery (including transport equipment) sectors with Japan with the U.S.

Other differences would surface if the tables are looked at row-wise. The chemical product sectors of both Japan and the U.S. received fairly large multiplier effects from a large number of the industries of Developing Asia. The magnitude of these effects were again larger on the Japanese chemical product sector. Similar cases are observed for the metal product and machinery sectors.

As has been pointed out earlier, the backward linkage effects through the open loop multipliers from Developing Asia on Japan (K_{21}) declined during the period of analysis. Table 6 shows the breakdown of the changes in inter-industry relations. The pattern of the changes in Table 6 resembles that of K_{21} itself except for the diagonal element for the 17th sector; machinery. The change in this element is positive. The multiplier effects on the chemical and metal product sectors (rows 12 and 16) and those from the transport equipment sector of Developing Asia (column 18) declined markedly, while the intra-industry relationship in the machinery sector in this direction intensified.

Thus, the linkages of the Japanese manufacturing sectors with those of Developing Asia were not only more intensive than the linkages of the U.S. with the region but underwent vigorous structural changes during the period of the analysis. The major driving forces of the changes were rapid industrialization in Developing Asia, the process which was reinforced by the relocation of the Japanese industries into the region.

Table 4 Inter-industry Effects from Developing Asia on Japan in 1985 (K_{21})

		8	9	10	11	12	13	14	15	16	17	18	19
8	Food Product												
9	Textile		O					●					
10	Wood Product												
11	Paper & Printing				●								
12	Chemical Product		●		●	●		O			o	o	O
13	Petroleum Product					o				o	o		
14	Rubber Product												
15	Non-metal Mineral Prod.								o				
16	Metal Product									●	O	◎	o
17	Machinery									o	●	O	o
18	Transport Equipment											●	
19	Other Manufactures											o	●

0.05 < ●

0.03 < ◎ < 0.05

0.02 < O < 0.03

0.01 < ● < 0.02

0.005 < o < 0.01

Table 5 Inter-industry Effects from Developing Asia on the U.S. in 1985 (L_{31})

		8	9	10	11	12	13	14	15	16	17	18	19
8	Food Product			●									
9	Textile			o									
10	Wood Product												
11	Paper & Printing				◎								
12	Chemical Product			o	o	◎		o					●
13	Petroleum Product					o	o						
14	Rubber Product												
15	Non-metal Mineral Prod.												
16	Metal Product									O	●	o	
17	Machinery										●	o	
18	Transport Equipment												o
19	Other Manufactures												

0.05 < ●

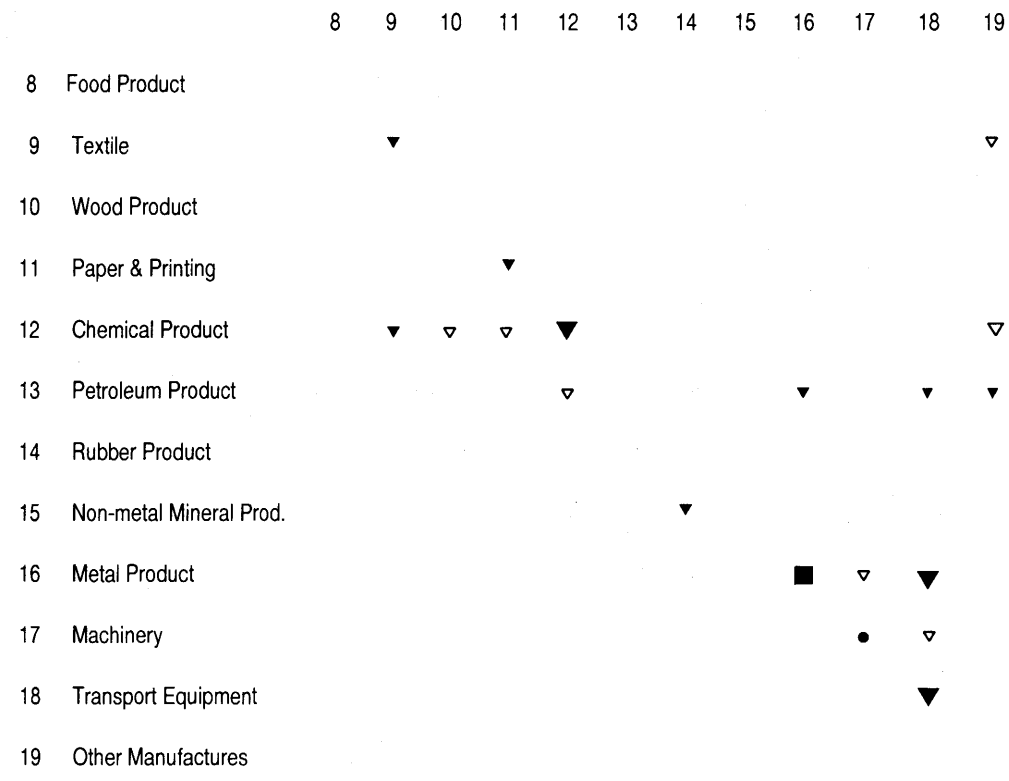
0.03 < ◎ < 0.05

0.02 < O < 0.03

0.01 < ● < 0.02

0.005 < o < 0.01

Table 6 Changes in Inter-industry Effects from Developing Asia on the Japan (Changes in K_{21} between 1975 and 1985)



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3. Foreign Direct Investment and Industrial Linkages

The findings in the preceding section may be somewhat surprising in view of the conventional wisdom that the structural adjustment in the Asia-Pacific region started on a massive scale only after the G5 Plaza Agreement in 1985 which triggered the realignment of major currencies.

As has clearly been shown in Table 2 and 3, substantial changes had already been taking place in the industrial linkages between Japan and Developing Asia before 1985. The changes were asymmetrical in that the dependence of the manufacturing sectors of Developing Asia on Japan declined to a large extent, while the changes in the opposite direction were moderate. We presented similar results in the framework of a trade linkage analysis using more recent data up to 1987 (Ino, et al. [1992]), in which Japan's trade linkages within Asia was shown to have declined in terms of its exports to the region but the country had increased its dependence on the region for imports.

Foreign direct investment of Japanese firms to the ASEAN countries and the other part of Asia has undoubtedly been the driving force which has brought about these changes. In fact, large decreases in the total backward linkage effects from Developing Asia on Japan are observed in those subsectors of manufacturing where heavy investments by Japanese firms were made by 1985 (Table 7). They include the textile, chemical product, metal product and transport equipment sectors. However, although investment in the machinery sector occupied almost 20 percent of the total foreign direct investment from Japan, the backward linkage effect in this subsector increased slightly.

The Japanese foreign direct investment increased tremendously in the latter half of the 1980's. The total amount of investment in the 5-year period from 1986 was nearly 50 percent more than the total investment in the preceding 35 years. The relationships between

Table 7 Foreign Direct Investment of Japan to Asia in Manufacturing Sectors

(million U.S. dollars and %)

	1951 – 80		1981 – 85		1986 – 90	
Food Product	148	(3.2)	108	(3.7)	911	(8.2)
Textile	920	(20.1)	261	(8.9)	685	(6.2)
Wood Product	142	(3.1)	49	(1.7)	335	(3.0)
Chemical Product	721	(15.8)	570	(19.3)	1349	(12.1)
Metal Product	1032	(22.6)	666	(22.6)	1107	(9.9)
Machinery	817	(17.9)	595	(20.2)	4411	(39.6)
(Electric Machinery)	544	(11.9)	289	(9.8)	3342	(30.0)
Transport Equipment	267	(5.8)	426	(14.5)	1006	(9.0)
Others	524	(11.5)	272	(9.2)	1336	(12.0)
Total	4571	(100.0)	2946	(100.0)	11140	(100.0)

Source: Ministry of Finance

the amount of foreign direct investment and the changes in the intensity of industrial linkages are not uniform. However, taking into account the scale of foreign direct investment from Japan, it is not hard to imagine that even more intensive structural changes have taken place during the second half of the 1980's than those observed in the present analysis.

Rapid increases in manufacture imports of Japan from the Asian countries after 1985 which raised the share of manufactures in Japan's total import from 30 percent in 1985 to more than 50 percent, together with increasing export of semi-finished products and parts, may suggest the increasing dependence of the Japanese industries on Developing Asia and/or the intensifying two-way industrial linkages between the two. The exact pattern of these changes, however, remains to be seen.

4. Concluding Remarks

This paper has analyzed the changing pattern of industrial linkages between Japan, the United States and the developing part of Asia. One of the major findings is that, in a relative sense, the dependence of the industries of Developing Asia on the Japanese industries, the strongest of the triangular relations in the Asia-Pacific region, had been becoming less intensive by 1985. In the place of the direct dependence of the Asian industries on Japan, the industrial linkages within Developing Asia, involving the subsidiaries of Japanese multinational companies have intensified to a considerable extent. The fact clearly indicates that there has been a net transfer of industries to Developing Asia during the period of the analysis.

The foreign direct investment from Japan to Developing Asia in the second half of the 1980's showed a clear departure from those in the preceding periods in both magnitude and sectoral compositions possibly bringing about even more drastic changes in the industrial structure in the West Pacific rim. However, the changes in the industrial linkages in the Asia-Pacific region observed during the period of this study were already very substantial. The Asian NIEs were recording very high growth in their pursuit to catch up Japan, and the ASEAN countries were consolidating their economies for the take off of their industrialization during the period. The observations in this study are both the conditions and outcomes of the economic development of the Asian developing countries. Future industrial development in the West Pacific clearly depends on continuous structural adjustment towards intensified industrial linkages based upon efficient division of labor between the economies of the region. In this sense, it is crucial for the countries of the region to further open up their economies and to keep expanding the frontiers of development by integrating less developed parts of the region into its industrial belt.

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